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Distribution and Abundance of *Cicindela dorsalis dorsalis*, the Northeastern Beach Tiger Beetle, Along the Western Shoreline of the Chesapeake Bay in Virginia

C. Barry Knisley

Department of Biology
Randolph-Macon College
Ashland, VA 23005

James M. Hill

RD 1, Box 27476
Reedville, VA 22539

Cindy A. Schulz

U. S. Fish and Wildlife Service, Virginia Field Office,
6669 Short Lane
Gloucester, VA 23061

INTRODUCTION

The disjunct historic range of *Cicindela dorsalis dorsalis* includes most of the coastal sandy beaches from New Jersey to Cape Cod and much of the eastern and western shorelines of the Chesapeake Bay from southern Maryland to Virginia (Knisley et al., 1987). Currently, this beetle is widely distributed and relatively abundant in Virginia, but only three populations occur north of Maryland, all of these in Massachusetts (Knisley & Hill, unpublished notes). Because of its dramatic decline in

range, *C. d. dorsalis* was listed as a Threatened species in 1990 under the U. S. Endangered Species Act (USFWS, 1990). Both before and after the listing there has been much survey and monitoring work to determine its distribution and abundance. However, most of this work is in unpublished reports and not readily available, except for limited distribution information in Knisley et. al. (1987).

The most extensive adult survey of *C. d. dorsalis* in Virginia was conducted by the Virginia Department of Conservation and Recreation (Division of Natural

Heritage) in 1989-90 (Buhlmann & Pague, 1992). This survey included most of the eastern and western shorelines of the Chesapeake Bay, but population estimates are not accurate for some sites where only limited sections of shoreline were surveyed. Also, some portions of the Bay shoreline with potential habitat were not surveyed. Additional information on the distribution and abundance of *C. d. dorsalis* is included in the Northeastern Beach Tiger Beetle Recovery Plan (USFWS, 1994). Results of more intensive surveys of selected sites are in Hill & Knisley (1994), Clark (1997), and Knisley (1997). Roble (1996) compiled the results of these reports and some additional records through 1996. His report also includes a list of some potential sites which were not surveyed for *C. d. dorsalis*. The objective of the study presented here was to conduct a thorough survey of adult *C. d. dorsalis* along the western shoreline of the Chesapeake Bay of Virginia, including all previously surveyed sites and others not before surveyed, to determine its current distribution and abundance. Surveys of adult beetles on the eastern Chesapeake Bay shoreline of Virginia are planned for the summer of 1999.

MATERIALS AND METHODS

We conducted most of our field surveys for adults from 0930 to 1630 h on warm, sunny days from June 29 to July 10, 1998. We surveyed several sites on July 12-17. Adults are typically at peak activity along the water edge during these hours and can be easily counted. Because the weather conditions on all of the survey dates were very similar and optimum for a high level of beetle activity, differences in adult numbers at the sites should not be attributable to weather. We selected the survey dates to be near the time of peak adult abundance and before beetles began to disperse. At this time, any beetles present at a site should be individuals which developed and emerged at the site rather than ones that moved in from another site. Studies conducted by Knisley & Hill (1990) in Maryland suggested that adults have a dispersal phase in mid-July at the time of peak seasonal abundance. We accessed several of the large Northumberland County sites by land but used a boat access to most of the sites. We started our surveys at Grandview Beach (City of Hampton) on June 29 and progressed north to Sandy Point, just north of the Yeocomico River mouth. At all known *C. d. dorsalis* sites and at any others that had a sandy beach that was at least 1 m wide (above high tide), we landed the boat along the shoreline and walked most or all of the length of the beach habitat searching for adult beetles. The survey method that was used to estimate the adult population size was an index count of all individuals that were observed during a walk through the entire site. Typically, one surveyor walked slowly along the water

edge and counted the beetles as they were flushed up from the beach ahead. Double counting typically did not occur because the beetles ran or flew to the upper beach upon approach. At the larger sites, two surveyors counted different sections of shoreline. At most sites we were able to count individual beetles, but where they were very dense, we counted by fives and tens. This type of index count method has been commonly used in tiger beetle surveys because it provides a good relative estimate and allows for comparison among sites and years, if survey conditions are favorable and a high percentage of the adult population is active on the beach. We used a GPS (Trimble Scoutmaster) to determine specific locations and lengths of the survey sites.

RESULTS

The numbers of adults counted at each site in the 1998 surveys are given in Table 1 along with the adult counts from surveys in previous years. We also include the approximate length of shoreline surveyed at each site. We surveyed a total of 107 sandy beach sites along the western shoreline of the Chesapeake Bay and found one or more *C. d. dorsalis* at 62 of these (Fig. 1). Sites ranged in length from 100 m to 2,700 m. Individual sites were typically bounded by inlets or other shoreline features, but some sites were not clearly separated from adjacent sites. Sites also differed in the nature of the shoreline, from natural, unmodified to highly modified with groins, bulkheads, or revetments. The total number of adults counted at all of these sites was 27,099. Twenty-three of the sites were new locations where the species had not been previously documented. Adults were absent from 9 of the 40 western shoreline sites where they were reported by Roble (1996). Among the 62 sites were 26 with small populations, <100 adults (14 with 1-25 individuals, 12 with 26-99), 21 sites with intermediate-sized populations, 100-500 adults, and 15 sites with large populations, >500 adults (8 sites with 501-1000 adults, and 7 with >1000). Sixteen of the new sites had small populations, but Oyster Creek had 2,159 adults, Chapel Creek had 608, and 5 sites had intermediate-sized populations. Generally, the sites with the longest shoreline had the greatest numbers of beetles (Table 1). Most of the sandy beach sites with no *C. d. dorsalis* were very narrow (less than 2 m of beach above high tide) and many of these were also highly modified with shoreline structures.

The distribution of *C. d. dorsalis* along the western shoreline ranged from Great Point, near the Yeocomico River in the north to Grandview Beach, north of the City of Hampton in the south. The distribution of sites (Fig. 1) was rather continuous from Northumberland County to Mathews County, but south of Mathews County to Grandview Beach there was a 25+ km section of shoreline

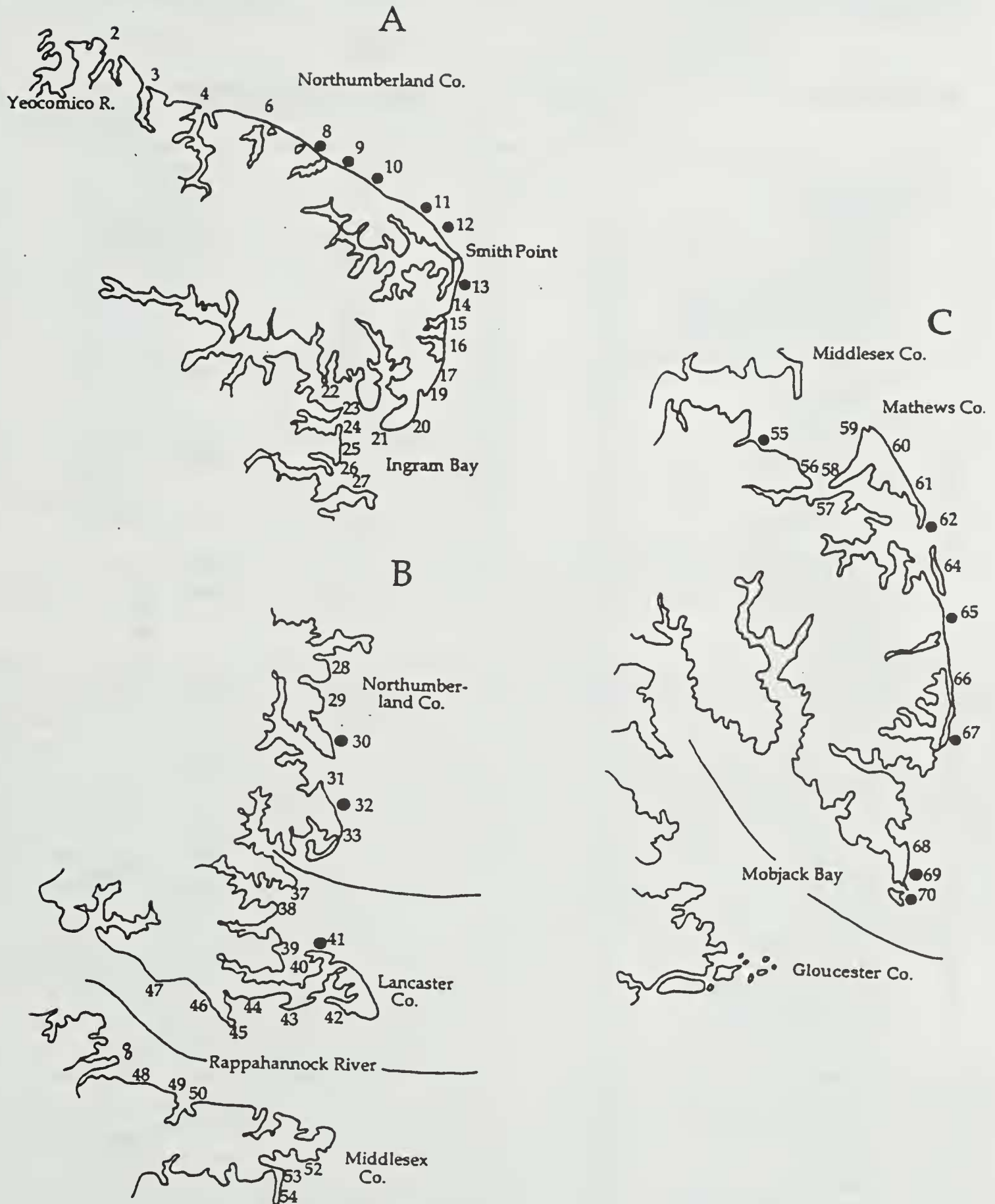


Fig. 1. Map of the western shoreline of the Chesapeake Bay showing the *C. d. dorsalis* sites. Missing numbers are sites where *C. d. dorsalis* occurred in previous surveys but not in 1998. Solid circles indicate sites with large populations (over 500 adults). Site 71 is not shown in this figure.

Table 1. Numbers of adult *Cicindela dorsalis dorsalis* counted in 1998 and in previous surveys at sites along the western shoreline of the Chesapeake Bay of Virginia.

Site	Site Name	Length of Site(m)	Numbers of <i>C. dorsalis</i> Counted:						
			1998	1997	1996	1995	1994	'89-93	1985
Northumberland County									
1	Balls Creek	200	0						6 ¹
2	Great Point(Cod Creek North)	200	2					5 ¹	
3	Prestly Ck.	1200	4		17 ²			10-15 ¹	
4	Neuman Neck South	1500	49		48 ²				
5	Bridgeman Ck.(Cordreys)	700	0						20 ¹
6	Marshalls Beach(Hull Neck)	700	2		0 ¹				
7	Lowes Pond North(Mob Neck)	600	0		21 ²				
8	Condit Pond-Hack Ck.(Mob Neck)	1700	5016		1128 ²				
9	Vir-Mar Beach	1300	795		829 ²	1019 ¹	1498 ²		
10	Ophelia Beach	1400	1872		863 ²				
11	Ginny Beach	400	1381		68 ²	91 ²	69 ²		
12	Smith Point North	1400	2727	3889 ³	2314 ³	1150 ²	3300 ²		
13	Smith Point South	2700	1209		624 ²		2130 ²		
14	Gaskin Pond North	600	106						
15	Gaskin Pond South	800	353						
16	Owens Pond	350	44		28 ⁴				
17	Chesapeake Beach North	350	283						
18	Chesapeake Beach	1200	0	2 ²			100 ³		
19	Taskmakers Creek	1000	210		486 ²		2637 ¹	179 ¹	
20	Bull Neck	600	5					36 ¹	
21	Fleeton Point	600	1		50 ⁴		0 ¹	86 ¹	
22	Haynie Point	200	191					258 ¹	
23	Sandy Point	1900	168		228 ²		365 ¹	768 ¹	
24	Bussel Point	350	4				25 ¹		
25	Towles Creek South	600	3						
26	Harveys Creek	350	132						
27	Dameron Marsh	1200	483				1678 ¹		
28	Ball Creek South	350	282						
29	W. Salt Pond-Ingram Cove	1000	95						
30	Hughlett Point	1900	588	994 ³	745 ³	2007 ¹			
31	Jarvis Point	200	131				130 ²		146 ²
32	Bluff Point Neck	2200	526					5/100m ¹	
33	Bluff Point	850	26						40 ¹
Lancaster County									
34	Bluff Point South	150	0						30 ¹
35	Henry Creek South	100	0						25 ²
36	Fleets Bay Neck Northwest	150	0						20 ¹
37	Rones Bay West	150	10						
38	Dymer Creek Southeast	150	8						
39	Little Bay West	350	76						
40	Little Bay Northeast	400	69					100 ¹	
41	Ovster Creek	1500	2159						
42	Fleets Island Southwest	1500	102						
43	Deep Hole Point	2100	372					2/100m ²	
44	Palmer East	1100	196						
45	Mosquito Point	600	184						
46	Mosquito Point Northwest Base	350	15						
47	East Cherry Point	400	280	133 ⁴				20 ¹	
Middlesex County									
48	Duck Pond	1200	28		142 ²	40 ¹			
49	Bush Park Creek	1200	169					63 ¹	
50	Timber Neck Northwest	700	3						
51	Stingray Point	1700	0					10-12 ¹	
52	Mill Creek Harbor	250	57	34 ⁴					
53	Stovepoint Neck Northeast	350	161						
54	Stovepoint Neck East Middle	250	14						

Table 1. Numbers of adult *Cicindela dorsalis dorsalis* counted in 1998 and in previous surveys at sites along the western shoreline of the Chesapeake Bay of Virginia.

Site	Site Name	Length of Site(m)	Numbers of <i>C. dorsalis</i> Counted:					
			1998	1997	1996	1995	1994	'89-93
Mathews County								
55	Chapel Creek	1000	608					
56	Hills Bay West	850	4					
57	Hills Bay South	250	43	48 ¹				
58	Narrows Point North	850	1				1 ¹	
59	Gwynn Island North	1200	191					
60	Gwynn Island East	1200	46		897 ²	510 ²		
61	Hills Creek East	600	79			66 ¹		
62	Sandy Point	1000	644			212 ¹		395/100m ¹
63	Lilleys Neck	500	0					3 ¹
64	Rigby Island	290	104				644 ¹	
65	Bethel Beach North(SR 643-609)	2400	996				267 ¹	
66	Bethel Beach	1400	271		847 ¹			700-2000 ¹
67	Winter Harbor	2400	608				308 ¹	>1000 ¹
68	Bavon Beach	2400	399					539 ¹
69	Bavon Beach South	500	853				332 ¹	
70	New Point	1000	1230			506 ¹		
City of Hampton								
71	Grandview Beach	1900	30				142 ¹	1406 ¹

1 from Roble (1996), 2 from Knisley (1997), 3 from Clark (1997), and 4 from Knisley's unpublished notes.

Mathews County, but south of Mathews County to Grandview Beach there was a 25+ km section of shoreline in Gloucester County, York County, and Poquoson City with no beetles. Most sites were very close to the open Chesapeake Bay except for several which occurred several km upriver beyond the mouths of the Potomac and Rappahannock Rivers. Twenty-nine sites were in Northumberland County, 11 in Lancaster County, 6 in Middlesex County, 15 in Mathews County, and 1 in the City of Hampton. A closer examination of the 1998 survey data indicated that most of the beetles were concentrated in four shoreline sections, each of which had numerous large and intermediate-sized populations. The greatest concentration with nearly half of all beetles counted was in the Smith Point portion of Northumberland County (sites 8 through site 15) with 13,459 adults. The other areas of concentration were in southern Mathews County (sites 62 through 70) with 5,105 adults, in Lancaster County along the shoreline of Fleets Island and continuing west along the north shore of the Rappahannock River (sites 41 through 47) with 3,308 adults, and in extreme southern Northumberland County (sites 27-32) with 2,965 adults.

The counts at many of the sites in 1998 were much different than those of previous years. Adult numbers at some of the Northumberland County (sites 8, 10, 11, 12) and Mathews County (62, 65, 67, 69, 70) sites with large

populations were higher or similar to the highest counts in previous years (Table 1). Other sites had moderate to drastically lower numbers in 1998 than in any previous year. For example, Gwynn Island East (site 60) went from a high of 897 in 1996 to 46, Grandview Beach (site 71) from a high of 1406 in (1991) to 30, Chesapeake Beach from a high of 100 in 1994 to 0, and Fleeton Point (site 21) from a high 86 in 1992 to 1. Lowest counts of any previous years were also recorded at Bethel Beach (site 66) and Hughlett Point (site 30), two of the sites protected by the Virginia Department of Conservation and Recreation.

DISCUSSION

The results of this recent survey increase the numbers of sites and total numbers of *C. d. dorsalis* adults along the western shoreline of the Chesapeake Bay from those reported by Roble (1996). Determining trends of population size and comparisons with previous counts are not valid for most sites because surveys were often done at different times in the seasonal cycle and by different surveyors, and sometimes a different portion of the site was surveyed. Many of the previous surveys were conducted later in the season (mid- to late July) when populations were at their seasonal peak and may also have included some individuals which immigrated from other

sites. We did record the presence and type of shoreline modifications at each site, but do not here evaluate their possible effects of *C. d. dorsalis* populations. Previous work by Knisley (1996) and Hill & Knisley (1995) indicated that sites with natural, wider shorelines had the largest numbers and densities of adults and larvae while modified shorelines with bulkheads and revetments had the lowest numbers and densities. The restriction of *C. d. dorsalis* to the open Bay shoreline and mouths of the large rivers probably indicates its preference to dynamic habitats where there is greater tidal activity and sand movement (USFWS, 1994). We expected that adult numbers would be lower in 1998 than previous years because most of our surveys were done 1-2 weeks before peak seasonal abundance and because of the unusually severe storm events (several hurricanes and northeasters) that occurred throughout the Chesapeake Bay in 1997 and 1998. The shoreline erosion resulting from these storms often reduces beach width and may cause direct mortality to adults and larvae, thus reducing population size. We cannot explain the absence of beetles from the long section of shoreline between Mathews County and Grandview Beach. We did notice in our survey of this area that there was very little potential habitat because much of the shoreline was marshy or with very narrow, modified or stabilized beaches.

The greatly reduced numbers of adults at Chesapeake Beach and Grandview Beach may have been due, in part, to the significant shoreline erosion we observed at these sites. However, at many other sites we observed comparable shoreline erosion but not a decline in adult numbers. Populations of *C. d. dorsalis* at the larger shoreline sites seem to be less severely affected by these storm events because erosion tends to occur only in limited sections of beach (Knisley & Hill, personal observations). Alternatively, storms may result in washovers and sand deposition which increase beach habitat for *C. d. dorsalis*. Regular monitoring (every 1-3 years) using uniform methods is needed at some or all of these shoreline sites so that we may more effectively assess population trends of the Chesapeake Bay *C. d. dorsalis* populations.

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New Locality Records for the Dismal Swamp Green Stink Bug (Heteroptera: Pentatomidae)

Richard L. Hoffman

Virginia Museum of Natural History
Martinsville, Virginia 24112

Steven M. Roble

Virginia Department of Conservation and Recreation
Division of Natural Heritage
217 Governor Street
Richmond, Virginia 23219

Eric L. Quinter

Department of Entomology
American Museum of Natural History
Central Park West at 79th Street
New York, New York 10024

Heretofore known only from the Great Dismal Swamp in extreme southeastern Virginia, the green stink bug *Chlorochroa (Rhytidolomia) dismalia* Thomas 1983, is justly considered one of the rarest pentatomids of North America. It was recommended for "Threatened" status in Virginia by Hoffman (1991), classified as a category 2 candidate species by the U.S. Fish and Wildlife Service from November 1991 until February 1996 (this category was formally abolished on the latter date), and ranked as GH/SH (globally/state historic) by the Virginia Division of Natural Heritage. The species is apparently known

only from the holotype (USNM) and a second specimen (LSU) from the Dismal Swamp (Schweitzer, 1989; Thomas, 1983). The former was collected on 2 August 1938 by L. D. Anderson (Thomas, 1983) and the latter (at Lake Drummond) on 13 June 1938 by A. M. Brues (L. H. Rolston, pers. comm.).

During a recent cursory scan of miscellaneous pentatomid material in the entomological collection of North Carolina State University (NCSU), Hoffman noticed that the tray headed "*Rhytidolomia senilis*" appeared to contain two rather different species.